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SOLAR ELECTRIC ENERGY

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All physical processes, and all vital activity, passing on the Earth are caused by solar energy.

Any energy (including electrical) used by man is the energy of the sun transformed many times artificially or naturally. We will consider the most direct way of obtain of electrical energy from the sun's energy. It uses the system of a semiconductor layers with different types of conductivity, or the layers of semiconductor and metal (depending on the type of system). Sunlight falls at one of the layers and causes an electrical current in the system layers. Such a system of semiconductor layers is called “solar cell”.

Many solar cells connected in series and/or in parallel are called a solar battery or photovoltaic module.

Many photovoltaic modules connected in series and/or in parallel are called a “solar array”.

The physical principle of solar cells

Semiconductor is the conductor, whose conductivity is slightly lower than of metal.

There are two basic types of semiconductors: p-type semiconductor and n-type semiconductor. The p-type semiconductor (p means positive) is obtained by carrying out a process of doping, that is adding a certain type of atoms to the semiconductor in order to increase the number of free charge carriers (in this case positive). In p-type semiconductor the admixture pulls an electron from the crystal lattice of the semiconductor and forms in a crystal lattice positive charge - a hole. N-type semiconductors (n means negative) are pure semiconducting materials (intrinsic semiconductors), which are doped with atoms capable of providing extra conduction electrons to the host material (e.g. phosphorus in silicon). This creates an excess of negative (n-type) electron charge carriers. In n-type semiconductor the admixture adds an electron to the conduction zone of the semiconductor and forms there positive charge - an electron.

Two such contiguous semiconductors with different types of conductivity form p-n junction. P-N junction is applied in various semiconductor devices (diodes, transistors, light emitting diodes, and others) and also in solar cells.

The processing in a solar cell, which causes the electromotive force (voltage) and electrical current consequently called a “photovoltaic effect”. In a photovoltaic cell, the photons of the incidental solar radiation break the ties of the semiconductor's electrons, thus allowing the electrons to move freely in the semiconductor. Sunlight is composed of photons, or "packets" of energy. These photons contain various amounts of energy corresponding to the different wavelengths of light. When photons strike a solar cell, they may be reflected or absorbed, or they may pass right through. When a photon is absorbed, the energy of the photon is transferred to an electron in an atom of the cell (which is actually a semiconductor). With its newfound energy, the electron is able to escape from its normal position associated with that atom to become part of the current in an electrical circuit.

One solar cell generates electromotive force with voltage 0.5 volt (with good sunlight). To increase the voltage, it is necessary to connect some solar cells consequentially. The current force depends on area of solar cell. To increase the current force it is necessary to increase the area of SC or to connect some solar cells parallel.

Domestic use of solar energy

Most homes get electricity from the local power company. The local power company is a part of what is called “the grid”. The power lines are part of the grid. The electricity from the grid enters the home through a meter.

By adding a solar energy or PV system to a home, the home can generate its own electricity. First, sunlight must be captured and converted from the light to electricity that is what PV-cells do. By grouping many cells into panel enough power is generated to run a home or business. The electricity that is created by the solar panels is DC or direct current electricity. DC electricity must be gather together and changed or inverted into AC or alternating current, which is the type of electricity found throughout a home. This is done with a piece of equipment called an inverter. The inverter is a very important part of the system.

Generally batteries are attached to the inverter to store the available power for using when there is no sun. The inverter provides the electricity necessary to run the home. If there is access power, generated by the PV system, the inverter can push the extra power out onto the grid.

Normally the wheel on a meter turns one way, as the power from the grid enters the home. But with a PV system installed it’s possible to turn the meter backwards. This means that instead of a home buying power from the grid, the home is selling power to the grid. And this is usually done in the form of credits. With the right PV system on a home or business, the expense for electricity which could be many thousands of rubles a year could be reduced to nearly zero.

Solar energy systems are good for the environment, and they can save a lot of money and energy in the long line.

Solar transport

A solar vehicle is an electric vehicle powered by solar energy. This is obtained from solar panels on the surface (generally, the top) of the vehicle. Solar vehicles are not practical day-to-day transportation devices at present, but are primarily demonstration vehicles and engineering exercises, often sponsored by government agencies.

Solar Cars.

Solar cars combine technology typically used in the aerospace, bicycle, alternative energy and automotive industries. The design of a solar vehicle is strictly limited by the amount of energy input into the car. Most solar cars have been built for the purpose of solar car races. Exceptions include solar-powered cars and utility vehicles.

Solar cars are often fitted with gauges as seen in conventional cars. In order to keep the car running smoothly, the driver must keep an eye on these gauges to spot possible problems. Cars without gauges almost always use wireless telemetry, which allows the driver's team to monitor the car's energy consumption, solar energy capture and other parameters and free the driver to concentrate on driving.

The car “Toyota Prius” is one of the most available car, equipped by solar module. This car is a hybrid with two engines: electrical and petrol. Electrical engine has a power 60 kilowatts. The accumulator battery in this car has a capacity 1310 Watt*Hours. Electrical engine is useful, when the car runs in city in intensively traffic, because electrical motor make to save a fuel and not to pollute an environment. When car stays at parking, the accumulator battery is charged by solar module.

Thus, using the Toyota Prius, you may not only to save a money, but also you make contributions to the preservation of the environment.

Solar powered aircrafts

HELIOS project was a part of NASA's ERAST programme (Environmental Research Aircraft and Sensor Technology). It was developed by NASA and Californian company AeroVironment Inc. ERAST programme develops pilotless solar powered airplane technology. The HELIOS construction was based upon its predecessors like NASA's solar plane Path-

finder, which was successfully tested a few years prior to HELIOS. Due to its speed HELIOS was able to flew over the same spot for days or weeks, therefore, in the future such aircrafts could substitute communication satellites. In the test flight on 13th August 2001, HELIOS reached the height of almost 30,000 meters. HELIOS was a slow airplane - if you ride a bicycle fast, you are quicker than HELIOS. It was a remotely controlled plane with no crew weighting less than most cars. However, it flew higher than any other plane powered solely by solar energy.

Pathfinder was a solar-powered, remotely piloted flying wing aircraft used to demonstrate the use of solar power for long-duration, high-altitude flight. Solar arrays provided up to 8 kW of power at high noon on a clear summer day. Pathfinder flew at typical airspeeds of 25 to 35 km/h. Pathfinder had a 30 m wing span, weighed 270 kg and was powered by six DC electric motors. It was built primarily of composites, plastic, and foam. In 1998, Pathfinder was modified into the Pathfinder Plus aircraft. Major activities of Pathfinder Plus's Hawaiian flights included detection of forest nutrient status, forest regrowth after damage caused by Hurricane Inki in 1992, sediment/algal concentrations in coastal waters, and assessment of coral reef health. Pathfinder Plus has a 36 m wing span and weighs about 318 kg. Pathfinder Plus has eight DC electric motors, its solar arrays produced about 12,5 kW of power.

Centurion has a 62 m wing span and it is powered by 14 brushless DC electric motors. The Centurion first flew in 1998. As with the Pathfinder/Pathfinder-Plus vehicles, the Centurion was further modified with the addition of a wing extension and a fifth landing-gear pod. Solar arrays have provided up to 31 kilowatts of power at high noon on a summer day to power the aircraft's motors, avionics, communications and other electronic systems. Centurion also has a backup lithium battery system.

The most available solar technologies.

Solar charger.

The solar “charger” can charge mini-electrical instruments including mobile phone, digital camera as well as mp3/mp4 and so on conveniently. For people who love travelling and outdoor sports, going on errand frequently and people who engaging in business, it can thoroughly eliminates their mini-electrical instrument's trouble of suddenly power-off when no power supply available.

Mobile phone with solar cells.

The company “Samsung” launched the first solar powered mobile phone, the Solar Guru E1107. The phone has photovoltaic panel at the back, which helps to charge the battery with sun light. Since the battery can be charged anywhere using the solar energy, the users don’t have to worry when the phone battery is running out of charge.